GEARED TURBOFAN GAS TURBINE ENGINE ARCHITECTURE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation in part of U.S. application Ser. No. 13/363,154 filed on Jan. 31, 2012 and claims priority to U.S. Provisional Application No. 61/653,762 filed on May 31, 2012.

BACKGROUND

[0002] A gas turbine engine typically includes a fan section, a compressor section, a combustor section and a turbine section. Air entering the compressor section is compressed and delivered into the combustion section where it is mixed with fuel and ignited to generate a high-speed exhaust gas flow. The high-speed exhaust gas flow expands through the turbine section to drive the compressor and the fan section. The compressor section typically includes low and high pressure compressors, and the turbine section includes low and high pressure turbines.

[0003] The high pressure turbine drives the high pressure compressor through an outer shaft to form a high spool, and the low pressure turbine drives the low pressure compressor through an inner shaft to form a low spool. The inner shaft may also drive the fan section. A direct drive gas turbine engine includes a fan section driven by the inner shaft such that the low pressure compressor, low pressure turbine and fan section rotate at a common speed in a common direction.

[0004] A speed reduction device such as an epicyclical gear assembly may be utilized to drive the fan section such that the fan section may rotate at a speed different than the turbine section so as to increase the overall propulsive efficiency of the engine. In such engine architectures, a shaft driven by one of the turbine sections provides an input to the epicyclical gear assembly that drives the fan section at a speed different than the turbine section such that both the turbine section and the fan section can rotate at closer to optimal speeds.

[0005] Although geared architectures have improved propulsive efficiency, turbine engine manufacturers continue to seek further improvements to engine performance including improvements to thermal, transfer and propulsive efficiencies.

SUMMARY

[0006] A gas turbine engine according to an exemplary embodiment of this disclosure, among other possible things includes a compressor section, a combustor in fluid communication with the compressor section, and a turbine section in fluid communication with the combustor. The turbine section includes a fan drive turbine and a second turbine. The fan drive turbine includes a plurality of turbine rotors. A fan includes a plurality of blades rotatable about an axis and a ratio between the number of fan blades and the number of fan drive turbine rotors is between about 2.5 and about 8.5. A speed change system is driven by the fan drive turbine for rotating the fan about the axis. The fan drive turbine includes a first aft rotor attached to a first shaft. The second turbine includes a second aft rotor attached to a second shaft. A first bearing assembly is disposed axially aft of a first connection between the first aft rotor and the first shaft. A second bearing assembly is disposed axially aft of a second connection between the second aft rotor and the second shaft.

[0007] In a further embodiment of the foregoing engine, the first bearing assembly and the second bearing assembly include roller bearings.

[0008] In a further embodiment of any of the foregoing engines, the compressor section includes a first compressor driven by the fan drive turbine through the first shaft. A second compressor section is driven by the second turbine through the second shaft. The first bearing supports an aft portion of the first shaft. The second bearing supports an aft portion of the second shaft.

[0009] In a further embodiment of any of the foregoing engines, a forward portion of each of the first and second shafts are supported by a thrust bearing assembly.

[0010] In a further embodiment of any of the foregoing engines, the fan drive turbine has a first exit area at a first exit point and rotates at a first speed. The second turbine section has a second exit area at a second exit point and rotates at a second speed, which is faster than the first speed. A first performance quantity is defined as the product of the first speed squared and the first area. A second performance quantity is defined as the product of the second speed squared and the second area. A performance ratio of the first performance quantity to the second performance quantity is between about 0.5 and about 1.5.

[0011] In a further embodiment of any of the foregoing engines, the performance ratio is above or equal to about 0.8.

[0012] In a further embodiment of any of the foregoing engines, the first performance quantity is above or equal to about 4.

[0013] In a further embodiment of any of the foregoing engines, the speed change system includes a gearbox. The fan and the fan drive turbine both rotate in a first direction about the axis. The second turbine section rotates in a second direction opposite the first direction.

[0014] In a further embodiment of any of the foregoing engines, the speed change system includes a gearbox. The fan, the fan drive turbine section, and the second turbine section all rotate in a first direction about the axis.

[0015] In a further embodiment of any of the foregoing engines, the speed change system includes a gearbox. The fan and the second turbine section both rotate in a first direction about the axis. The fan drive turbine rotates in a second direction opposite the first direction.

[0016] In a further embodiment of any of the foregoing engines, the speed change system includes a gearbox. The fan is rotatable in a first direction and the fan drive turbine. The second turbine section rotates in a second direction opposite the first direction about the axis.

[0017] In a further embodiment of any of the foregoing engines, the speed change system includes a gear reduction having a gear ratio greater than about 2.3.

[0018] In a further embodiment of any of the foregoing engines, the fan delivers a portion of air into a bypass duct. A bypass ratio being defined as the portion of air delivered into the bypass duct divided by the amount of air delivered into the compressor section, with the bypass ratio being greater than about 6.0.

[0019] In a further embodiment of any of the foregoing engines, the bypass ratio is greater than about 10.0.

[0020] In a further embodiment of any of the foregoing engines, a fan pressure ratio across the fan is less than about 1.5.

[0021] In a further embodiment of any of the foregoing engines, the fan has 26 or fewer blades.